



Sustainable development of energy, water and environment systems

Neven Duić^{a,*}, Zvonimir Guzović^a, Vyatcheslav Kafarov^b, Jiří Jaromír Klemeš^c, Brian van Mathiessen^d, Jinyue Yan^e

^a Department of Energy, Power Engineering and Environment, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Ivana Lučića 5, 10000 Zagreb, Croatia

^b Director of Center for Sustainable Development in Industry and Energy, Industrial University of Santander, Cr. 27, #9 Bucaramanga, Colombia

^c Centre for Process Integration and Intensification – CPI2, Research Institute of Chemical and Process Engineering, Faculty of Information Technology, University of Pannonia, Egyetem u. 10, H-8200 Veszprém, Hungary

^d Aalborg University, Department of Development and Planning, A.C. Meyers Vænge 15, DK-2450 Copenhagen SV, Denmark

^e Royal Institute of Technology (KTH) and Mälardalen University (MDU), Sweden Editor-in-Chief of Elsevier Int. Journal, Applied Energy

HIGHLIGHTS

- This special issue of contributions presented at the 6th SDEWES Conference.
- Buildings are becoming energy neutral.
- Process integration enables significant improvements of energy efficiency.
- The electrification of transport and measures to increase its efficiency are needed.
- Renewable energy is becoming more viable while being complicated to integrate.

ARTICLE INFO

Article history:

Received 26 July 2012

Accepted 3 August 2012

Available online 11 September 2012

Keywords:

Sustainable development

Energy

Water

Environment

ABSTRACT

The 6th Dubrovnik Conference on Sustainable Development of Energy, Water and Environment Systems (SDEWES Conference), attended by 418 scientists from 55 countries representing six continents. It was held in 2011 and dedicated to the improvement and dissemination of knowledge on methods, policies and technologies for increasing the sustainability of development, taking into account its economic, environmental and social pillars, as well as methods for assessing and measuring sustainability of development, regarding energy, transport, water and environment systems and their many combinations.

© 2012 Elsevier Ltd. All rights reserved.

The European Union in its energy and climate change policy has decided to set up binding target of 20% renewables in gross final energy demand, to reduce greenhouse gases emissions by 20% and to increase the energy efficiency by 20% by 2020, on the way to decreasing greenhouse gas emissions by 80–95% by 2050 [1]. A significant technology shift will be necessary to fulfil such goals, but it is already clear that technologies that will be used are available, mainly in the area of renewable electricity and heat generation, bio-fuels and electricity for transport, energy efficiency, especially in buildings and transportation, cogeneration and process integration, nuclear energy in those countries in which it is politically acceptable, which will all be achieved by a combination of binding targets, certificate trading, financial mechanisms and fiscal policies. How to make the whole process more of an opportunity than a cost is a cru-

cial question. The green economy should not only help solve all the above issues but also provide for employment and regional development. With the change of direction slowly happening in other countries, being brought by economic gains stemming from new technology sectors development, the intertwining of security of energy supply, environmental protection and green economy is becoming a new global tenet.

The 6th Dubrovnik Conference on Sustainable Development of Energy, Water and Environment Systems (SDEWES Conference) was attended by 418 scientists from 55 countries representing six continents. It was held in 2011 and was dedicated to the improvement and dissemination of knowledge on methods, policies and technologies for increasing the sustainability of development, taking into account its economic, environmental and social pillars, as well as methods for assessing and measuring sustainability of development, regarding energy, transport, water and environment systems and their many combinations.

* Corresponding author. Tel.: +385 91 5285443; fax: +385 1 6156940.

E-mail address: Neven.Duic@fsb.hr (N. Duić).

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” [2]

This special issue of contributions presented at the SDEWES Conference, will try to help energy researchers and experts in this time of considerable policy shift, to have an insight into the things to come.

Buildings, which typically use 30–40% of primary energy, are becoming energy neutral, meaning very efficient and in the same time autonomous sources of energy needed to cover its needs. Marinakis et al. [3] reports on an integrated system for service buildings' energy-efficient automation while Pukšec et al. [4] reports potentials for energy savings and long term energy demand of Croatian households sector.

Process integration enables significant improvements of energy efficiency. Thus Zhang et al. [5] reports on sustaining high energy efficiency in existing processes with advanced process integration technology, while Klemeš et al. [6] describes advanced multimedia engineering education in energy, process integration and optimisation. Mikulčić et al. [7] reports on reducing the CO₂ emissions in Croatian cement industry by improving the calcination process while Gazda and Koziol [8] estimates energy efficiency for hybrid refrigeration system. Kostowski and Usón [9] gives thermoeconomic assessment of a natural gas expansion system integrated with a co-generation unit and Kravanja and Čuček [10] reports on multi-objective optimisation for generating sustainable solutions considering total effects on the environment. Chacartegui et al. [11] reports on gas and steam combined cycles for low calorific syngas fuels utilisation.

Transport is the sector with highest rate of energy demand growth, while already using some 30% of primary energy. The electrification of transport and other measures to increase its efficiency are urgently needed. Foley [12] reports on the influence of electric vehicle charging to the electricity market operation while Bartolozzi et al. [13] gives comparison between hydrogen and electric vehicles by life cycle assessment, on a case study in Tuscany. Navarro et al. [14] calculates CO₂ emissions from a spark ignition engine operating on natural gas–hydrogen blends (HCNG) and Cipek et al. [15] reports a control-oriented simulation model of a power-split hybrid electric vehicle.

Wind energy is the most cost efficient renewable energy while being complicated to integrate into the power systems due to its intermittency. Pandžić et al. [16] reports on virtual power plant mid-term dispatch optimisation, Capuder et al. [17] on specifics of integration of wind power plants into the Croatian transmission network, Perković et al. [18] on using the Magnus' effect to harvest more constant high altitude wind energy for energy power production while Krajačić et al. [19] analyses the financial mechanisms in support to new pumped hydropower storage projects that could be a way to resolve intermittency problem.

Nagy and Körmendi [20] reports on use of renewable energy sources in light of the “New Energy Strategy for Europe 2011–2020”, Schlör et al. [21] reports on methods of measuring sustainable development of the German energy sector while Golušin et al. [22] reports on transition from traditional to sustainable energy development in the region of Western Balkans.

Biomass is one of the most used renewable resources. Sánchez et al. [23] reports on aspects of using *Isochrysis galbana* for biodiesel production, Niza et al. [24] on biodiesel production by non-catalytic supercritical methyl acetate, Heyne and Harvey [25] assesses the energy and economic performance of second generation bio-fuel production processes using energy market scenarios, Gonzalez del Campo et al. [26] reports on short-term effects of temperature and COD in a microbial fuel cell, Blanco-Marigorta et al. [27] on exergetic analysis of a biodiesel production process from *Jatropha*

Curcas, Gonzalez et al. [28] evaluate alternatives for microalgae oil extraction based on exergy analysis, Duncan et al. [29] evaluates torrefied, spherical biomass pellets through the use of experimental design while Žandeckis et al. [30] reports on a solar and pellet combisystem for apartment buildings.

Ruelas et al. [31] reports on a mathematical model to develop a Scheffler-type solar concentrator coupled with a Stirling engine. Vučijak et al. [32] reports on applicability of multicriteria decision aid to sustainable hydropower while Dubreuil et al. [33] reports on water modelling in an energy optimisation framework in the water scarce Middle East context.

Not all greenhouse gas emissions can be avoided by energy efficiency and renewable energy. The rest should be treated by some other means. One option is to have them captured and stored. Gerbelová et al. [34] reports on the effect of retrofitting Portuguese fossil fuel power plants with CCS.

Sustainability sciences also being a perfect field for interdisciplinary and multi-cultural evaluation of complex systems, the Dubrovnik Conference has during the first decade of the 21st century became a significant venue for researchers in those areas to meet, and discuss, share, and disseminate new ideas.

References

- [1] European Commission. Energy roadmap 2050. COM (2011) 885 final of 15 December, 2011.
- [2] World Commission on Environment and Development. Our common future. Oxford: Oxford University Press; 1987.
- [3] Marinakis V, Doukas H, Karakosta C, Psarras J. An integrated system for buildings' energy-efficient automation: application in the tertiary sector. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.05.032>.
- [4] Pukšec T, Mathiesen BV, Duić N. Potentials for energy savings and long term energy demand of Croatian households sector. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.04.023>.
- [5] Zhang N, Smith R, Bulatov I, Klemeš JJ. Sustaining high energy efficiency in existing processes with advanced process integration technology. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.02.037>.
- [6] Klemeš JJ, Kravanja Z, Varbanov PS, Lam HL. Advanced multimedia engineering education in energy, process integration and optimisation. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.01.039>.
- [7] Mikulčić H, Vujanović M, Duić N. Reducing the CO₂ emissions in Croatian cement industry. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.02.083>.
- [8] Gazda W, Koziol J. The estimation of energy efficiency for hybrid refrigeration system. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.05.006>.
- [9] Kostowski WJ, Usón S. Thermoeconomic assessment of a natural gas expansion system integrated with a co-generation unit. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.04.002>.
- [10] Kravanja Z, Čuček L. Multi-objective optimisation for generating sustainable solutions considering total effects on the environment. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.04.025>.
- [11] Chacartegui R, Sánchez D, Muñoz de Escalona JM, Muñoz A, Sánchez T. Gas and steam combined cycles for low calorific syngas fuels utilisation. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.02.041>.
- [12] Foley A, Tyther B, Calnan P, Ó Gallachóir B. Electric vehicle charging and electricity market operation. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.06.052>.
- [13] Bartolozzi I, Rizzi F, Frey M. Comparison between hydrogen and electric vehicles by life cycle assessment: a case study in Tuscany. Italy Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.03.021>.
- [14] Navarro E, Leo TJ, Corral R. CO₂ emissions from a spark ignition engine operating on natural gas–hydrogen blends (HCNG). Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.02.046>.
- [15] Cipek M, Pavković D, Petrić J. A control-oriented simulation model of a power-split hybrid electric vehicle. Appl Energy 2012.
- [16] Pandžić H, Kuzle I, Capuder T. Virtual power plant mid-term dispatch optimization. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.05.039>.
- [17] Capuder T, Pandžić H, Kuzle I, Škrlec D. Specifics of integration of wind power plants into the Croatian transmission network. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.05.002>.
- [18] Perković L, Silva P, Ban M, Kranjčević N, Duić N. Harvesting high altitude wind energy for energy power production: the concept based on Magnus' effect. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.06.061>.
- [19] Krajačić G, Lončar D, Duić N, Raguzin I. Analysis of financial mechanisms in support to new pumped hydropower storage projects in Croatia. Appl Energy 2012.
- [20] Nagy K, Körmendi K. Use of renewable energy sources in light of the “new energy strategy for Europe 2011–2020”. Appl Energy 2012;96:393–9.

- [21] Schlör H, Fischer W, Hake JF. Methods of measuring sustainable development of the German energy sector. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.05.010>.
- [22] Golušin M, Munitlak Ivanović O, Redžepagić S. Transition from traditional to sustainable energy development in the region of Western Balkans – current level and requirements. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.06.008>.
- [23] Sánchez Á, Maceiras R, Cancela Á, Pérez A. Culture aspects of *Isochrysis galbana* for biodiesel production. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.03.027>.
- [24] Niza NM, Tan KT, Lee KT, Ahmad Z. Biodiesel production by non-catalytic supercritical methyl acetate: thermal stability study. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.03.033>.
- [25] Heyne S, Harvey S. Assessment of the energy and economic performance of second generation biofuel production processes using energy market scenarios. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.03.034>.
- [26] Gonzalez del Campo A, Lobato J, Cañizares P, Rodrigo MA, Fernandez Morales FJ. Short-term effects of temperature and COD in a microbial fuel cell. Appl Energy 2012, doi:10.1016/j.apenergy.2012.02.064.
- [27] Blanco-Marigorta AM, Suárez-Medina J, Vera-Castellano A. Exergetic analysis of a biodiesel production process from *Jatropha Curcas*. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.05.037>.
- [28] Gonzalez A, Kafarov V, Alvarez Y. Evaluation of alternatives for microalgae oil extraction based on exergy analysis. Appl Energy 2012.
- [29] Duncan A, Pollard A, Fellouah H. Torrefied, spherical biomass pellets through the use of experimental design. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.03.035>.
- [30] Zandekis A, Timma L, Blumberga D, Rochas C, Rošā M. Solar and pellet combisystem for apartment buildings: heat losses and efficiency improvements of the pellet boiler. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.03.049>.
- [31] Ruelas J, Velázquez N, Cerezo J. A mathematical model to develop a Scheffler-type solar concentrator coupled with a Stirling engine. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.05.040>.
- [32] Vučijak B, Kupusović T, Midžić-Kurtagić S, Čerić A. Applicability of multicriteria decision aid to sustainable hydropower. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.05.024>.
- [33] Dubreuil A, Assoumou E, Selosse S, Bouckaert S, Maizi N. Water modeling in an energy optimization framework – the water scarce Middle East context. Appl Energy 2012.
- [34] Gerbelová H, Versteeg P, Ioakimidis CS, Ferrão P. The effect of retrofitting Portuguese fossil fuel power plants with CCS. Appl Energy 2012. <http://dx.doi.org/10.1016/j.apenergy.2012.04.014>.